

THE PRAIRIE PENINSULA AND SECONDARY
INTERGRADATION IN *PHOTINUS* FIREFLIES
(COLEOPTERA: LAMPYRIDAE)^{1,2}By JAMES E. LLOYD³

The literature dealing with organisms having distributions that extend from the plains states in a north-easterly direction to the Lower Great Lakes is extensive (see Transeau, 1935; Schmidt, 1938; Thomas, 1951; Thomas and Alexander, 1962). Studies of these organisms and investigations dealing with palynology, and glacial geology, have led to the conclusion that during a warm, dry (Xerothermic) period following the Wisconsin glaciation many western species extended their ranges eastward through a prairie extension. The range of the firefly *Photinus curtatus* Green suggests such a history. This case is of special interest since *curtatus* intergrades extensively in central New York State with a firefly of apparent eastern origin (Fig. 1)

The flashed mating signals and time of mating activity of the two forms are similar (Lloyd, 1966). They can be separated only by male genitalia (Green, 1956). Green named specimens having the lateral aedeagal lobes shaped like mittens, with thumblike dorsal branches, *P. curtatus* (Fig. 2). He considered those having hook-like lateral lobes, and attenuated dorsal branches and median lobes, to be *P. marginellus* LeConte (Fig. 2). None of the specimens seen by Green during his study were intergrades (personal communication), and the eastern limit of *curtatus* given by him was near Buffalo, New York. I have found virtually every degree of genitalic intermediacy between *curtatus* and *marginellus* in the Mohawk Valley of New York between Buffalo and Albany.

Figure 3 shows the genitalia of specimens of *marginellus* and *curtatus* that were collected outside the zone of overlap. Figure 4 shows the genitalia of intermediates that were collected in the Mohawk Valley. A simple "hybrid" index (Fig. 2) facilitates comparison. Index values for *marginellus* range between 0.6 and 1.0, for *curtatus* between 0.2 and 0.4 (Fig. 3) and for intergrades between 0.4 and 0.7 (Fig. 4).

I made extensive field collections and observations in New York, and examined several hundred specimens both from my own and museum collections. The following points are noted:

1. The only museum collection with obvious intergrades was the Albany collection (not seen by Green). Both intergrades and *curtatus* were present in Albany County in 1894 (Fig. 5). *P. marginellus* specimens from Albany County are dated 1902-1927 (Fig. 5).

2. Only five "possible intergrades" were found in collections from localities outside of New York State (Fig. 5).

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3. In 1963 I collected specimens in the Mohawk Valley in Madison, Oneida, Herkimer, Fulton, and Montgomery Counties. They occurred along the roadsides, in hayfields, over lawns, and at forest edges in great abundance. Index values for these specimens ranged from 0.25 to 0.70 (the range for intergrades). Two *marginellus* specimens were found in the Mohawk Valley in Cayuga County (0.79, 0.80).

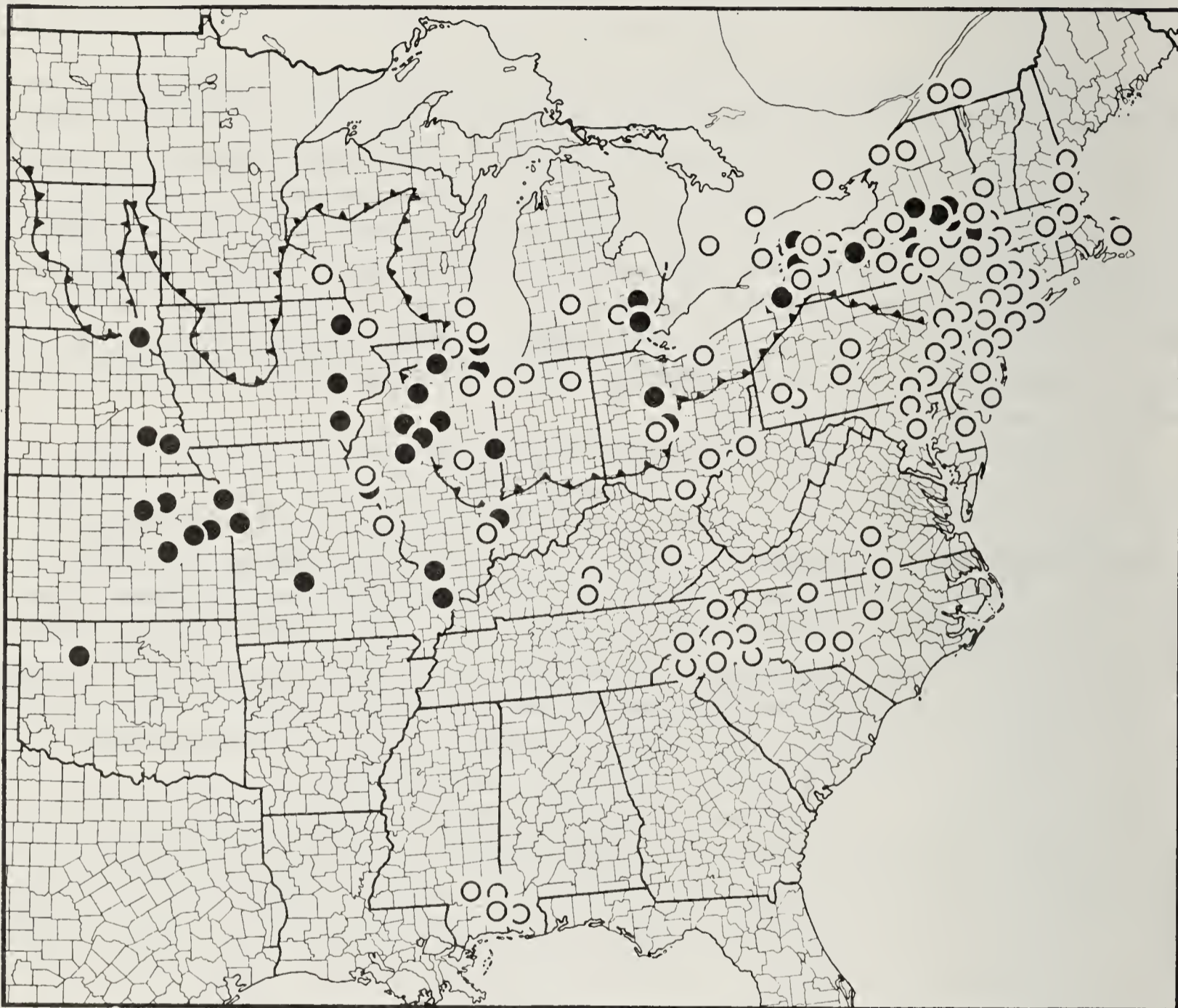


FIGURE 1. Dots = *curtatus*. Circles = *marginellus*. Toothed line = limit of Wisconsin Glacier.

4. Collections made in central New York from Oneida Lake in the Mohawk Valley southward over the hills and into the Chenango River Valley, southward along the Chenango River Valley, and along the highways that climb out of the Chenango Valley into the hills to the east and west revealed the following:

(a) From Oneida Lake southward the mean index for samples changed from 0.54 to 0.24 over a distance of about 30 miles; 20 miles further south it was 0.25 (Fig. 6).

(b) At Greene, Chenango County (about 55 miles south of Oneida Lake), the trend had reversed and the mean index value was 0.30 (Fig. 6).

(c) About 6 miles south of Greene mean index values for demes at the edge of the valley reached high (*marginellus*) levels; the indices for demes on the riverbank did not reach these same levels for 2 more miles (Fig. 6).

(d) All demes sampled along the highways in the hills to either side of the valley had high (*marginellus*) indices ($\bar{x} = 0.76$; Fig. 6).

DISCUSSION

Hypotheses based on the data thus far assembled must be tentative. Many more samples must be made and additional observations on behavior and ecology are necessary. The following, based on present data, are suggested:

1. The Wisconsin Glacier separated an ancestral population into eastern and western components.

2. During separation these populations diverged; the western population adapted to a warm, dry climate, and the eastern population to a damp, cool climate.

3. Following retreat of the glacier the western population expanded its range eastward along the prairie peninsula, and the eastern population expanded westward over the Appalachian and Adirondack Mountains, and into the Mohawk Valley.

4. The two forms met in the Mohawk Valley (perhaps ecological conditions are somewhat intermediate there), and both forms continue to enter the area; *curtatus* from the west, and *marginellus* from the neighboring mountains.

5. *P. curtatus* is ecologically favored in the hills of southern Madison County, New York, since the region has been extensively altered by agriculture. *P. curtatus* is not favored in Chenango County, New York, because great forest areas remain.

6. The agriculturalized Chenango Valley offers an avenue for continued range expansion in *curtatus*, and the attenuated vanguard of *curtatus* within the valley is a result of continuing southward movement.

I do not believe *curtatus* merits specific rank; a formal change in taxonomy will, however, be deferred until additional observations have been made.

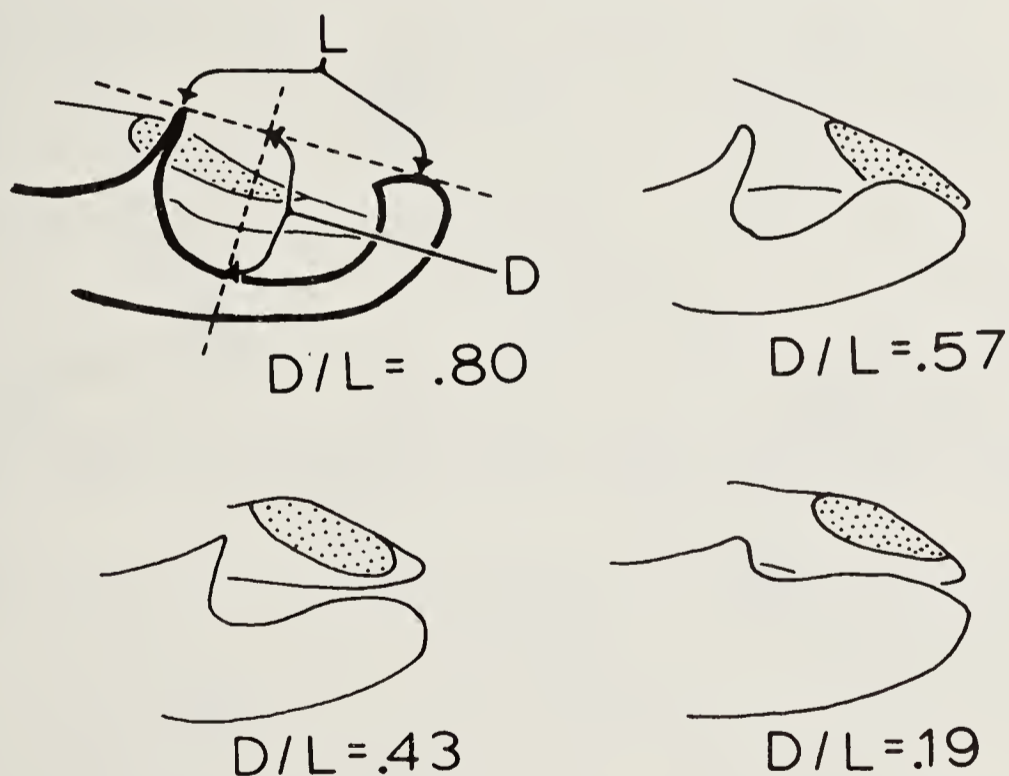


FIGURE 2. Right paramere and median lobe of the two forms and intergrades. *marginellus* = 0.80; intergrades = 0.43 and 0.57; *curtatus* = 0.19. Method of calculating index is shown at upper left.

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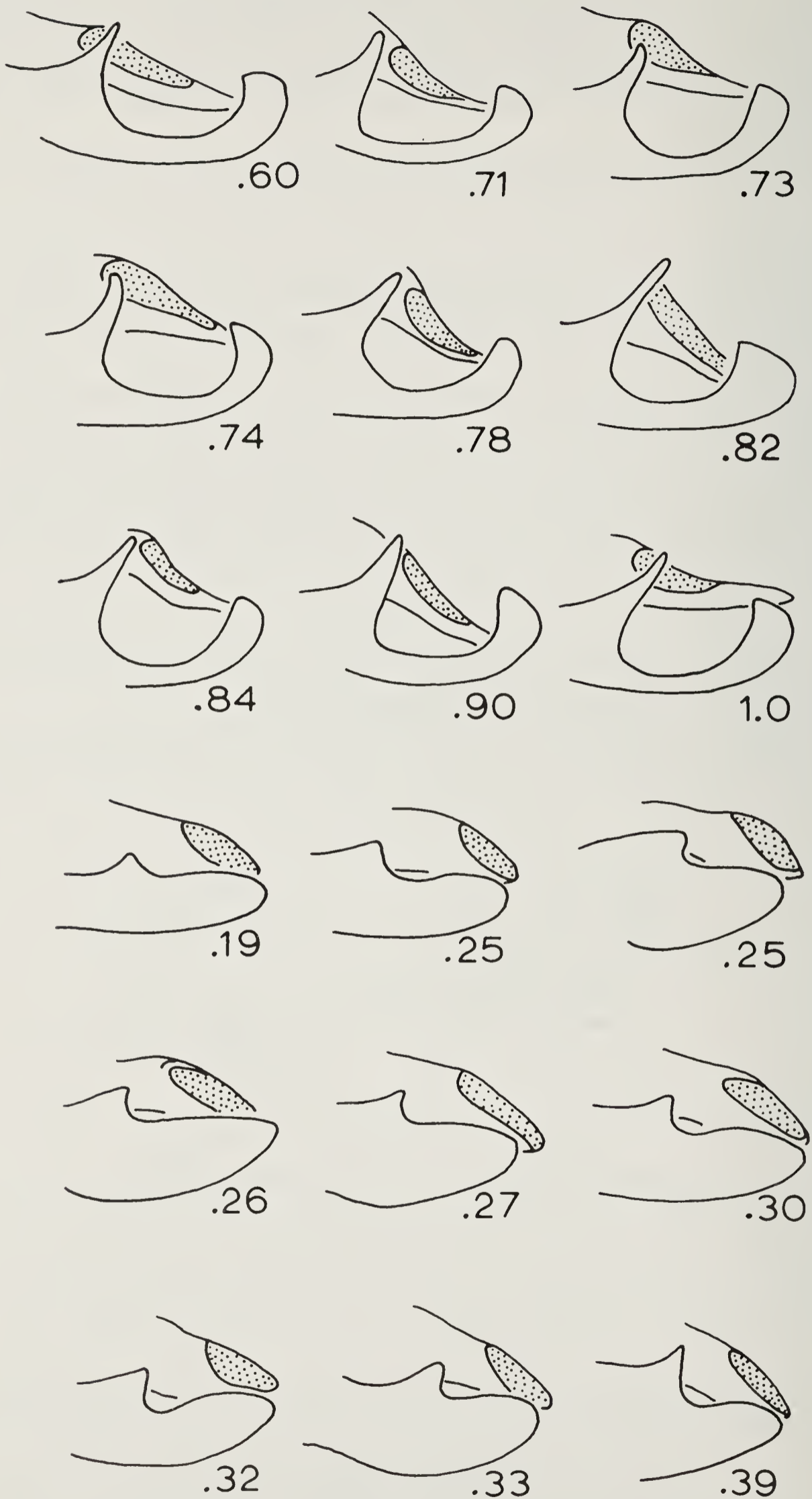


FIGURE 3. Upper nine (.60-1.0) right paramere and median lobe of *marginellus* collected outside zone of sympatry. Lower nine (.19-.39) right paramere and median lobe of *curtatus* collected outside zone of sympatry.

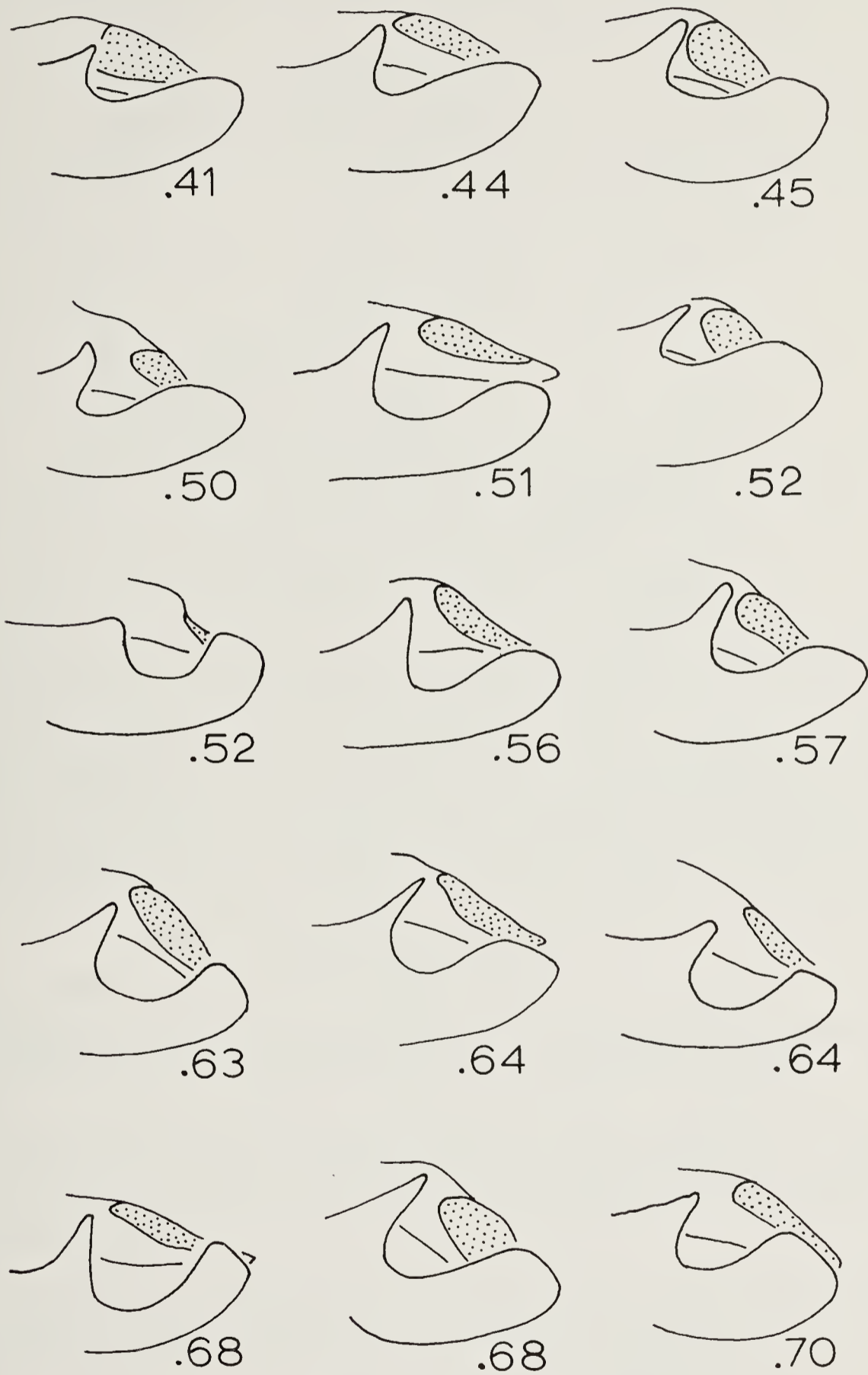


FIGURE 4. Right paramere and median lobe of intergrades collected in the Mohawk Valley.

the University of Michigan made helpful suggestions and criticisms on the manuscript.

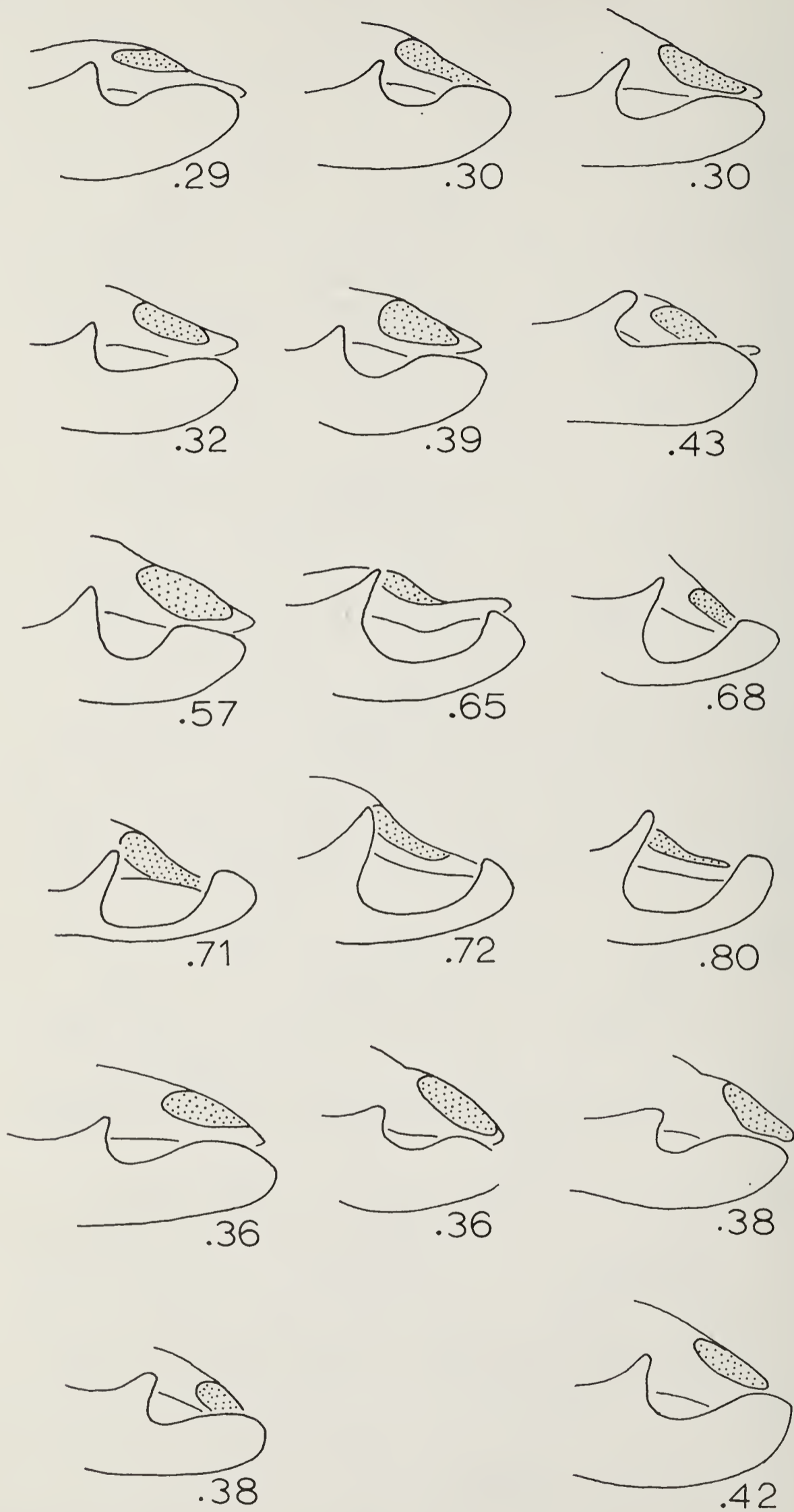


FIGURE 5. Upper seven (.29-.57) right paramere and median lobe of specimens collected in Albany County, 1890-1894. Drawings .65-.80 from specimens collected in Albany County, 1905-1920. Lower five "possible intergrades" (.36-.42), collected in Peoria and Menard Counties, Illinois; Franklin County, Ohio; Oakland County, Michigan; Wayndotte County, Kansas.

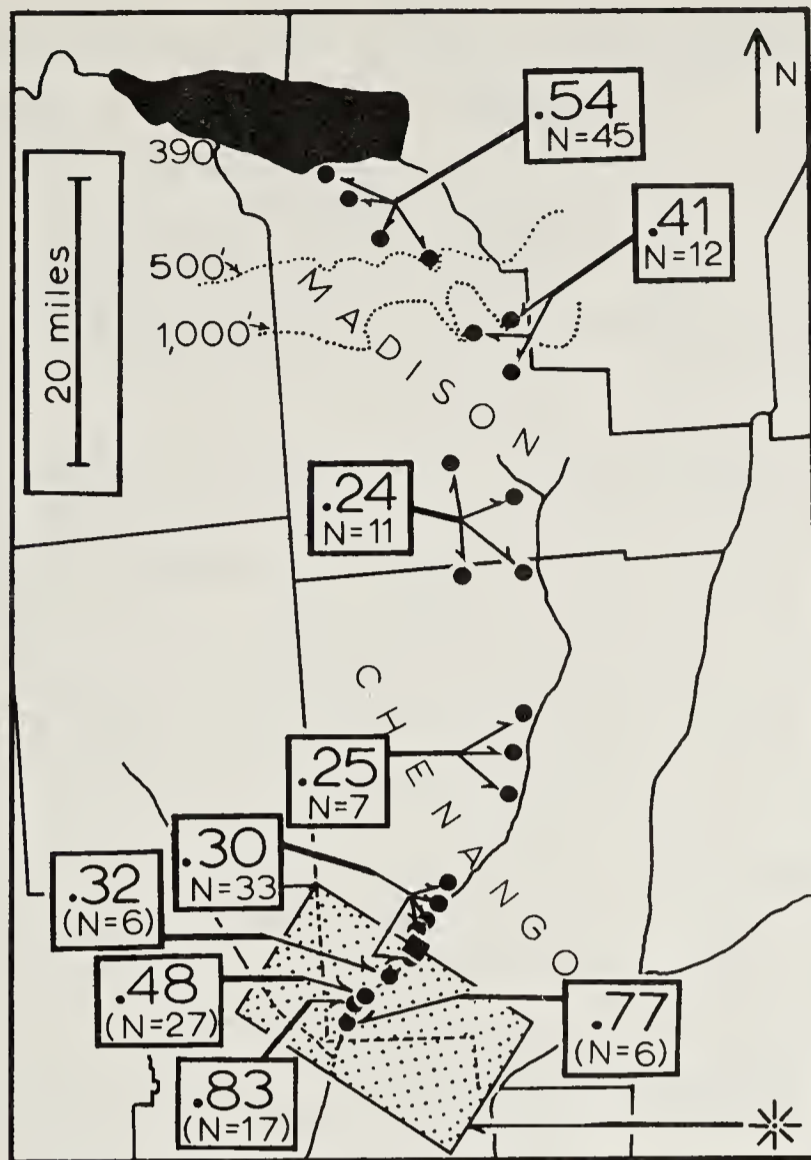


FIGURE 6. Sampling transect from Oneida Lake in Mohawk Valley southward to northern Broome County. Dots indicate sampling sites; black square at edge of stippled area is Greene; dotted contour lines indicate edge of Mohawk Valley; stippled rectangle indicates area of greatest study concentration. Sample means are shown in boxes; in the Chenango Valley only means for riverbank samples are given (see text). Distance between the .48 site and .83 site was less than 300 yards. The .83 value is higher than the mean value for *marginellus* samples made outside the area of sympatry ($\bar{x} = 0.76$, $n = 31$, range 0.60-1.0). This high value (.83) may be the result of sampling error, or may indicate genetic disturbance resulting from contact with *curtatus*.

*In the hills to the east and west of the Chenango Valley, $\bar{x} = 0.76$, $n = 36$, range = 0.62-0.93.

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